

## **NCBN Protocol Development Summary**

**Protocol:** Estuarine Nutrient Inputs

**Parks Where Protocol will be Implemented:** CACO, GATE, FIIS, ASIS, COLO

### **Justification/Issues being addressed:**

Nutrient enrichment of the coastal zone is a worldwide consequence of human population growth. The Northeast (from Maine to Maryland) currently accounts for about one third of the coastal population of the entire United States (NOAA 1998). The population density of this narrow coastal fringe is more than double that of any other region of the country, and it continues to grow. The consequent residential, agricultural, and urban expansion will result in a continued increase in anthropogenic nutrient loading to the region's coastal zone. Estuaries can generally assimilate some degree of enrichment without major ecological ramifications, but excessive nutrient inputs typically lead to dense blooms of phytoplankton and fast-growing macroalgae, loss of seagrasses, and decreased oxygen availability in sediments and bottom waters (Valiela et al. 1992, Nixon 1995, Borum 1996, Bricker et al. 1999). Cascading effects may include changes in the species composition and abundance of invertebrates, decline in fish and wildlife habitat value, and the collapse of commercially harvestable fin- and shellfish stocks.

For a monitoring program to address questions regarding the causes of estuarine nutrient enrichment and trends in loading rates, monitoring variables must be related to the primary nutrient sources. Nutrients from land-derived sources are delivered to estuaries in surface and ground water flow. Quantifying actual loads of nitrogen and phosphorus requires spatially and temporally intensive measurement of stream and groundwater flux and nutrient concentrations (e.g. Doering et al. 1995, Nielsen 2002), and is beyond the scope of a regional monitoring program. However, the human activities contributing to increased nutrient delivery to coastal waters are well documented and are tractable at the landscape scale. While it would be most desirable to obtain direct measures of nutrient inputs, especially nitrogen (N), to the estuarine waters of the Northeast Coastal and Barrier Network parks, such an effort may not prove to be sustainable over the long term. Surface discharges are event driven and therefore difficult to predict and sample adequately. And while the field collection of surface waters for nutrient analyses is relatively straightforward, acquiring representative ground water samples is technically difficult. The laboratory facilities and staff required to carry out the analytical work for nutrient analyses are probably not within the financial or human resources of most of the parks. For these reasons, a protocol is being developed by the network to monitor estuarine nutrient agents of change, or potential sources of nutrients within the watersheds of each of the parks. These proxy indicators of nutrient enrichment will include such things as: human population numbers, permitted water withdrawals for agriculture, fertilizer consumption, and landuse.

### **Specific Monitoring Questions and Objectives to be Addressed by the Protocol:**

**Objective 1: Determine if nutrient loads to Park estuaries are increasing.**

- **Question 1:** *Can the following land-use proxies for nutrient loads: human population density, non-point source discharge permits, permitted water withdrawals for domestic and agricultural consumption, fertilizer consumption, livestock populations be used to estimate nutrient inputs into Park estuaries?*
  - **Vital Sign 1:** Estuarine Nutrient Inputs

## **Vital Signs, measurements, justifications and basic approach:**

### **Vital Sign:** Estuarine Nutrient Inputs

- **Measurement:** Nutrient point source discharge permits, livestock populations, fertilizer consumption, permitted water withdrawals for domestic and agricultural consumption, wet deposition N chemistry.
- **Justification:** The major land-derived sources of nutrient pollution are fertilizers and wastewater (Valiela et al. 1992, Nixon 1995). Nutrients from agricultural fields and domestic septic systems enter streams and groundwater through runoff and leaching, where they contribute to nonpoint sources of enrichment. Domestic wastewater is also delivered to estuaries as point-source sewage discharge. Increasing nutrient loads in streams and groundwater are consequently associated with high rates of urbanization and agricultural expansion. Data on land use within the watersheds surrounding park estuaries are readily available throughout the North Atlantic region as an indicator of nonpoint-source nutrient loads delivered in streams and groundwater, and the number of sewage and industrial effluent discharges permitted in the vicinity of park waters provides data on point-source inputs. Atmospheric deposition of nitrogen from fossil fuel combustion and fertilizer volatilization may also form a significant portion of the total nitrogen load to coastal waters, particularly in estuaries that are large relative to the size of their watersheds (NRC 2000).

### **Basic Approach:**

Agents of Change variables are already gathered by local, state, and federal agencies. Regional testing involves determining the geographic scope of watershed data relevant for each network park, compiling current and historic (at 10-year intervals back to 1970) data from existing sources, and developing trajectories for each variable over time. This analysis will be used to identify the most useful indicators of nutrient load and to prepare guidance for updating the NPS database from other specific sources.

A monitoring protocol is being developed describing in detail how the historic data were compiled and reviewed as well as how to update this inventory, analyze and evaluate the new information for the network on a scheduled basis.

### **Principal Investigators and NPS Lead:**

Protocol development will be done through a cooperative agreement with the USGS Patuxent Wildlife Research Center, 26 Ganneston Drive. Augusta, ME 04330 and the University of Rhode Island's (URI) Graduate School of Oceanography. Principal Investigators are Scott W.

Nixon from University of Rhode Island, and Hilary A. Neckles and Blaine S. Kopp from USGS. NPS Leads: Bryan Milstead and Sara Stevens.

### **Development Schedule, Budget, and Expected Interim Products:**

The Patuxent and URI PIs will develop and draft the full inclusive monitoring protocol, to include an extensive narrative describing the full protocol as well as specific SOPs, by October 2005. After peer review, revision and approval is expected by March 2006. We budgeted \$90,000 in FY 2002 for protocol development.

### **Literature Cited**

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